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Biological Characteristics of Adult Atlantic Salmon (*Salmo salar*) in the Buctouche River, New Brunswick, 1992 to 2000

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Abstract

Atkinson, G. 2001. Biological characteristics of adult Atlantic salmon (*Salmo salar*) in the Buctouche River, New Brunswick, 1992 to 2000. Can. Data Rep. Fish. Aquat. Sci. 1076: 22p.

Beginning in 1992, adult Atlantic salmon were captured at various counting facilities installed on the Buctouche River for the purposes of stock assessment. This report summarizes the information collected on length, sex ratios, age and spawning history from 1992 to 2000. These characteristics are very similar to those of Miramichi River salmon, and typical of stocks in adjacent rivers which flow into Northumberland Strait.

Key words: Atlantic salmon, New Brunswick, Buctouche River, biological characteristics, stock assessment.

Résumé

Atkinson, G. 2001. Biological characteristics of adult Atlantic salmon (*Salmo salar*) in the Buctouche River, New Brunswick, 1992 to 2000. Can. Data Rep. Fish. Aquat. Sci. 1076: 22p.

Depuis 1992, des saumons atlantiques adultes ont été capturés à diverses barrières de dénombrement situées dans la rivière Bouctouche afin d'évaluer l'état des stocks. Le présent rapport résume l'information recueillie sur la longueur, l'âge, la proportion relative des sexes, et l'historique de frai des saumons capturés entre 1992 et 2000. Ces caractéristiques sont très semblables à celles des saumons de la rivière Miramichi, et typiques des stocks des rivières proches qui se déchargent dans le Détroit de Northumberland.

Mots-clés : saumon atlantique, Nouveau-Brunswick, rivière Bouctouche, caractéristiques biologiques, évaluation de stock.

Introduction

The Buctouche River (also spelled Bouctouche) is situated in Kent County, southeast New Brunswick and flows in an easterly direction to Northumberland Strait in Fisheries Statistical District 77, Salmon Fishing Area 16 (Fig. 1). It is a small, shallow, low gradient system with no man-made barriers to ascending fish. A spawning run of Atlantic salmon, composed of approximately two-thirds multi-sea-winter fish, enters the river during September and October. The stock is considered to be essentially wild. In 1978-79 the river was stocked with a total of 37,049 fall fingerlings of Miramichi/Sevogle River origin (Newbould 1983), the results of which were never assessed. In 1996-97 a total of 81,867 fall fingerlings of Buctouche River parentage were released, small numbers of which have returned.

In the past, Buctouche salmon were exploited in a commercial fishery, for food by Buctouche First Nation, and by recreational anglers. Commercial harvesting of Atlantic salmon ceased as of 1984, and beginning the same year, angling regulations have required that large salmon (63 cm or more) be released and only small salmon (less than 63 cm) could be retained. Due to consistently low returns of salmon in recent years, all harvesting was curtailed in the Buctouche and other southeast New Brunswick rivers, as of 1998.

The salmon run in the Buctouche has been sampled yearly since 1992, and adult returns have been assessed since 1993 (Atkinson and Claytor MS1994, Atkinson *et al.* MS1995, Atkinson and Chaput MS1996, Atkinson *et al.* MS 1997, Atkinson *et al.* MS 1998, Atkinson *et al.* MS 1999, Atkinson *et al.* 2000, Atkinson and Peters 2001). Under the Aboriginal Fisheries Strategy (AFS) agreements the Department of Fisheries and Oceans (DFO) provides funding and training to First Nations in the interest of developing a co-management approach to the resource. Assessments up to and including 1998 were accomplished through mark-recapture experiments in which tags were applied at one or both of two estuary trapnets operated by Buctouche First Nation, and recovered in the recreational fishery or at a counting fence upriver, operated by the Southeastern Anglers Association. Since 1999, returns were estimated from the catches at, and the calculated efficiency of, one estuary trapnet operated by Buctouche First Nation.

This report summarizes the information collected on length, sex ratios, age and spawning history of the Atlantic salmon captured at the above mentioned facilities, from 1992 to 2000.

Methods

In co-operation with Buctouche First Nation, one or two trapnets were operated between 1992 and 2000 in the tidal portion of the Buctouche River to mark and recapture salmon. Trapnet 1 was located 3 km upriver (west) of the Route 11 bridge in Bouctouche, New Brunswick; Trapnet 2 was two km further upstream from this point (Fig. 1). The box portion of the traps measured 3.7 m (12') wide by 18.3 m (60') long and was constructed with 5.7 cm (2.25") mesh knotless nylon. A single leader of approximately 61 m (200'), extending from shore into a door in the middle of the long side of the box, was made from 14 cm (5.5") mesh polypropylene. The traps were configured to fish in an upstream direction.

To more effectively recapture marked fish, a counting fence was installed (1994-1998) on the main stem of the river 2.75 km upstream from the head of tide, just below the confluence of the South Branch (Fig. 1). In 1984 the fence consisted of two trapnets about 6 m (20') long by 2.7 m (9') wide and connected to the shore by leaders in a "J" configuration to trap fish moving both up and downstream. In the following years a single trap with "V" leaders was used to trap upstream migrants only, as fish tended not to move down until after the fence was removed, or remained in the pool immediately above. The trap and leaders were constructed with 5.7 cm (2.25") knotless nylon mesh, held in place with steel rods (rebar) driven into the stream bed. Members of the Southeastern Anglers Association operated the fence.

The years and dates of operation of the trapnets and counting fence are shown in Table 1. Generally, the facilities were tended daily except when weather was extreme (trapnets) or water was too high (fence). Fork length was measured, usually to the nearest 0.5 cm, for nearly all fish caught. Scale samples were taken from all fish for determination of age and spawning history unless it was physically too injurious to remove them, as in the case of some males. Exceptions occurred at the counting fence in 1994 when every third, and in 1997 every second, fish was scale sampled. Ageing of scales was done with either a microfiche reader or a dissecting microscope. Sex determination was made on external characters (relative jaw length, presence or absence of kype), that for late run fish are reliable, even for small salmon. At the trapnets in 1992, fish were not sexed, and in 2000 no data of any kind was recorded for the ten small salmon captured. After sampling, fish were marked with Carlin tags at trapnets, or tail-punched at the fence, and released. Given that sampling generally occurred over most or all of the brief duration of the run and that no systematic bias appears to have been introduced in the sampling regime, it is felt that the assumption of overall randomness in the samples is reasonably justified.

Results

Total annual catches of small salmon ranged from 10 to 69, and large salmon from 16 to 142, representing 26-71%, and 16-71% of respective total estimated returns as per assessments noted above (Table 2). The size dichotomy into "small" and "large" reliably translates into the sea-age categories referred to as one-sea-winter and multi-sea-winter respectively. Exceptions occur, but infrequently in this stock. Size is used in this instance because returns are normally assessed in terms of small and large fish. Further analysis will rely on age determinations exclusively. It should be noted that figures in Table 2 will not always coincide with sample sizes mentioned subsequently, as not all biological parameters described in the text were determined for all fish caught.

Adult returns to the Buctouche sampled between 1992 and 2000 can all be placed in five spawning categories: one, two and three sea-winter (1SW, 2SW, 3SW) first-time spawners (referred to as maiden or virgin), and repeat spawners that returned first as either 1SW or 2SW maidens (referred to here as R-1SW and R-2SW, respectively). Within these groups freshwater age, or age at smoltification, ranged from two to four years (Table 3, Fig. 2). In five of nine years, three-year smolts dominated the 1SW fish, but overall there was not a large difference between two (44%) and three (52%) year olds. This pattern was essentially reversed in the smolt ages of repeat spawners, which had returned initially as 1SW fish (R-1SW). However, these fish were uncommon hence the sample size was small (N=19). Four-year smolts were rare, occurring only among 1SW salmon where they made up 4% of total samples. Within the maiden 2SW group, two-year smolts predominated in five of nine years, and for all years comprised 72% of samples, versus 28% for three-year-olds. As might be expected, overall smolt age contributions in repeats that spawned first as 2SW maidens virtually mirrors this, with 70% and 30%, respectively. Maiden 3SW fish were very rare; only two have been sampled, one of which had a discernible smolt age of two years.

Fish of sea age two years or more, regardless of spawning history, are collectively referred to as multi-sea-winter (MSW) salmon. In eight of the nine years sampled, the largest component of this category was the 2SW maidens, ranging from 69-93% of all MSW fish (Table 4, Fig. 3). The single exception was 1998, when only 33% were 2SW and the bulk of large salmon samples were repeat spawners (67%). For all years, 2SW maidens comprised 80% of MSW salmon. Repeat spawners have constituted 6-67% of MSW fish with an overall average of 19%. Of all repeats, fish that spawned initially as 2SW maidens (R-2SW) were the most numerous, constituting 50-100% (mean 79%) of the total (Fig. 4), and 3-53% (mean 15%) of all MSW samples. Repeats that spawned first as 1SW maidens (R-1SW) were relatively uncommon, representing 0-50% (mean 21%) of repeats and only 0-13% (mean 4%) of MSW salmon.

Total sea age did not exceed six years during the period sampled, and the large majority of fish (82%) were two-year-olds (Table 5). Except in 1992, fish of three or more sea years were repeat spawners. The maximum number of previous spawnings was three: one, two and three-time previous spawners accounted for 77%, 19% and 4% respectively, of all repeats sampled. Alternate and consecutive year repeat spawners were the two most common patterns seen, representing 48% and 42% of previous spawners (Table 6). Most alternate spawners were sea age four or more, and consecutive, three or less. Nine percent of the sample had switched from alternate to consecutive spawning (assuming success in the year sampled). These were five and six-year-old fish that had previously spawned two or three times. Only one fish, a five-year-old, was switching (in the year sampled) from consecutive to alternate spawning. All fish of sea age four or more were 2SW repeat spawners.

The female component of 1SW salmon varied from 3-21% of the total, with a mean of 11%; of 2SW maidens from 70-100% with a mean of 86% (Table 7). Means for respective repeat spawning categories were almost identical with their maiden counterparts. Overall, 83% of MSW salmon were females. Among virgin spawners, the female proportion was higher in fish of freshwater age two, compared with those of age three (Table 8). This difference was greatest for 1SW salmon, where 16% of age two were female, but only 8% of age three. Of repeat spawning 1SW fish there was a higher proportion of females in age three smolts but sample sizes were small. Maiden 2SW salmon had slightly more females in the two-year smolt group (90% vs 82%) but showed little difference as repeat spawners (85% vs 86%).

Mean fork length for 1SW maiden fish was 56.2 cm and for 2SW, 76.3 cm (Table 9, Fig. 5). Maiden 3SW salmon were sampled in 1992 only: these two fish averaged 100.5 cm. Males averaged 1.4% and 2.1% longer than females for 1SW and 2SW virgin fish, respectively. All MSW salmon pooled averaged 78.5 cm, which was 2.2 cm longer than maiden 2SW fish. While mean lengths showed annual variability, there was no significant trend. Mean length of repeat spawners varied with sea age, pattern of spawning and number of previous spawnings (Tables 10, 11). Repeat 1SW salmon averaged 74.6 cm, repeat 2SW, 89.6 cm. Overall mean length of repeats was 86.6 cm. Alternate repeat spawning 1SW salmon were larger than maiden 2SW and very similar to consecutive repeat 2SW fish. For a given sea age, fish returning in alternate or initially alternate years were longer than those displaying other patterns of spawning.

The Biological characteristics of Buctouche River salmon are generally similar to those observed for Miramichi River fish, particularly in the late run, as observed since 1984 when commercial fishing ceased and angling retention of large salmon was banned (Moore *et al.* 1995, Atkinson and Moore 1999, and unpublished data). These traits are believed to be typical of salmon stocks in other southeastern New Brunswick, Northumberland Strait rivers.

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Table 1. Operation dates of salmon capture facilities on the Buctouche R., 1992-2000.

Year	Trapnet 1	Trapnet 2	Counting Fence
1992	Oct. 7 - Nov. 3	-	-
1993	Jul. 24 - Nov. 4	Oct. 6 - Nov. 4	-
1994	Sep. 28 - Nov. 4	Oct. 31 - Nov. 4	Oct .8 - Nov. 23
1995	Sep. 18 - Oct. 29	Sep. 22 - Oct. 29	Oct. 11 - Nov. 9
1996	-	Sep. 17 - Oct. 28	Oct. 9 - Nov. 3
1997	Sep. 21 - Oct. 27	Sep. 9 - Oct. 27	Oct. 3 - Nov. 7
1998	Sep. 15 - Nov. 4	Sep. 10 - Nov. 5	Oct. 7 - Oct. 23
1999	-	Sep. 1 - Oct. 16	-
2000	-	Sep. 16 - Nov. 3	-

Table 2. Number of salmon caught relative to estimated total returns, Buctouche R., 1992-2000. * "Other" includes angled fish and those seized by fishery officers. Note: figures in this table may not agree with sample sizes indicated elsewhere, as not all biological parameters described in the text were measured for all fish caught.

Year	Salmon	Trapnet 1	Trapnet 2	Counting Fence	Other *	Total Catch	Estimated Returns	Catch as % of Returns
1992	Small	20	-	-	-	20	-	-
	Large	65	-	-	-	65	-	-
1993	Small	23	3	-	1	27	78	35%
	Large	29	11	-	4	44	95	46%
1994	Small	6	1	47	-	54	77	70%
	Large	32	6	81	-	119	225	53%
1995	Small	17	35	17	-	69	98	70%
	Large	12	35	7	-	54	154	35%
1996	Small	-	25	33	-	58	127	46%
	Large	-	26	43	-	69	134	51%
1997	Small	4	32	33	-	69	97	71%
	Large	21	32	89	-	142	200	71%
1998	Small	1	7	19	-	27	92	29%
	Large	2	16	14	-	32	102	31%
1999	Small	-	29	-	-	29	115	25%
	Large	-	40	-	-	40	244	16%
2000	Small	-	10	-	-	10	38	26%
	Large	-	16	-	-	16	100	16%

Table 3. Freshwater (FW) ages of salmon from the Buctouche R., 1992-2000.

		Maiden Spawners						Repeat Spawners				
	FW Age	1SW		2SW		3SW		R-1SW		R-2SW		Total
Year	Years	N	Prop.	N	Prop.	N	Prop.	N	Prop.	N	Prop.	N
1992	2	4	0.21	50	0.94	1	1.00	1	0.50	2	1.00	58
	3	14	0.74	3	0.06	0	0	1	0.50	0	0	18
	4	1	0.05	0	0	0	0	0	0	0	0	1
	All Ages	19		53		1		2		2		77
1993	2	11	0.42	14	0.34	0	0	1	1.00	1	0.50	27
	3	10	0.38	27	0.66	0	0	0	0	1	0.50	38
	4	5	0.19	0	0	0	0	0	0	0	0	5
	All Ages	26		41		0		1		2		70
1994	2	13	0.42	34	0.76	0	0	1	0.33	7	0.70	55
	3	17	0.55	11	0.24	0	0	2	0.67	3	0.30	33
	4	1	0.03	0	0	0	0	0	0	0	0	1
	All Ages	31		45		0	0	3		10		89
1995	2	38	0.58	20	0.50	0	0	1	1.00	4	0.40	63
	3	26	0.40	20	0.50	0	0	0	0	6	0.60	52
	4	1	0.02	0	0	0	0	0	0	0	0	1
	All Ages	65		40		0		1		10		116
1996	2	34	0.72	43	0.88	0	0	2	0.67	4	1.00	83
	3	12	0.26	6	0.12	0	0	1	0.33	0	0	19
	4	1	0.02	0	0	0	0	0	0	0	0	1
	All Ages	47		49		0		3		4		103
1997	2	12	0.26	80	0.95	0	0	1	0.33	12	0.75	105
	3	35	0.74	4	0.05	0	0	2	0.67	4	0.25	45
	4	0	0	0	0	0	0	0	0	0	0	0
	All Ages	47		84		0		3		16		150
1998	2	7	0.27	4	0.44	0	0	3	0.75	14	0.88	28
	3	19	0.73	5	0.56	0	0	1	0.25	2	0.13	27
	4	0	0	0	0	0	0	0	0	0	0	0
	All Ages	26		9		0		4		16		55
1999	2	9	0.32	9	0.29	0	0	1	0.50	4	0.67	23
	3	17	0.61	22	0.71	0	0	1	0.50	2	0.33	42
	4	2	0.07	0	0	0	0	0	0	0	0	2
	All Ages	28		31		0		2		6		67
2000	2	-	-	8	0.73	0	0	0	0	2	0.40	10
	3	-	-	3	0.27	0	0	0	0	3	0.60	6
	4	-	-	0	0	0	0	0	0	0	0	0
	All Ages	-		11		0		0		5		16
All Years	2	128	0.44	262	0.72	1	1	11	0.58	50	0.70	452
	3	150	0.52	101	0.28	0	0	8	0.42	21	0.30	280
	4	11	0.04	0	0	0	0	0	0	0	0	11
	All Ages	289		363		1		19		71		743

Table 4. Spawning composition of MSW salmon, Buctouche R., 1992-2000.

	Maiden Spawners				Repeat Spawners								All MSW
	2SW		3SW		R-1SW			R-2SW			All Repeats		
Year	N	Prop. of MSW	N	Prop. of MSW	N	Prop. of Repeats	Prop. of MSW	N	Prop. of Repeats	Prop. of MSW	N	Prop. of MSW	N
1992	58	0.91	2	0.03	2	0.50	0.03	2	0.50	0.03	4	0.06	64
1993	41	0.93	0	0	1	0.33	0.02	2	0.67	0.05	3	0.07	44
1994	45	0.78	0	0	3	0.23	0.05	10	0.77	0.17	13	0.22	58
1995	41	0.79	0	0	1	0.09	0.02	10	0.91	0.19	11	0.21	52
1996	49	0.88	0	0	3	0.43	0.05	4	0.57	0.07	7	0.13	56
1997	88	0.82	0	0	3	0.16	0.03	16	0.84	0.15	19	0.18	107
1998	10	0.33	0	0	4	0.20	0.13	16	0.80	0.53	20	0.67	30
1999	31	0.79	0	0	2	0.25	0.05	6	0.75	0.15	8	0.21	39
2000	11	0.69	0	0	0	0	0	5	1.00	0.31	5	0.31	16
All years	374	0.80	2	0.00	19	0.21	0.04	71	0.79	0.15	90	0.19	466

Table 5. Sea age and number of spawnings of MSW salmon from the Buctouche R., 1992-2000.

				No. of fish that spawned 'S' times				
	Sea Age			Maidens	Repeat Spawners			Proportion Previously
Year	Years	N	Prop.	S=0	S=1	S=2	S=3	Spawned
1992	2	59	0 92	58	1	0	0	0 02
	3	4	0 06	2	2	0	0	0 50
	4	1	0 02	0	1	0	0	1 00
	5	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0
	All Ages	64	1 00	60	4	0	0	0 06
1993	2	41	0 93	41	0	0	0	0
	3	2	0 05	0	2	0	0	1.00
	4	0	0	0	0	0	0	0
	5	1	0 02	0	0	1	0	1 00
	6	0	0	0	0	0	0	0
	All Ages	44	1 00	41	2	1	0	0 07
1994	2	47	0.81	45	2	0	0	0 04
	3	5	0.09	0	5	0	0	1 00
	4	6	0.10	0	4	2	0	1 00
	5	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0
	All Ages	58	1 00	45	11	2	0	0 22
1995	2	41	0.79	41	0	0	0	0
	3	4	0 08	0	4	0	0	1 00
	4	6	0.12	0	5	1	0	1 00
	5	0	0	0	0	0	0	0
	6	1	0 02	0	0	1	0	1 00
	All Ages	52	1.00	41	9	2	0	0 21
1996	2	51	0.91	49	2	0	0	0 04
	3	1	0.02	0	1	0	0	1 00
	4	3	0 05	0	3	0	0	1 00
	5	1	0 02	0	0	1	0	1 00
	6	0	0	0	0	0	0	0
	All Ages	56	1.00	49	6	1	0	0 13
1997	2	90	0 84	88	2	0	0	0 02
	3	3	0 03	0	3	0	0	1 00
	4	6	0 06	0	5	1	0	1 00
	5	6	0 06	0	0	4	2	1 00
	6	2	0 02	0	0	1	1	1 00
	All Ages	107	1 00	88	10	6	3	0 18
1998	2	11	0.37	10	1	0	0	0 09
	3	5	0 17	0	5	0	0	1 00
	4	13	0 43	0	12	1	0	1 00
	5	1	0 03	0	0	0	1	1 00
	6	0	0	0	0	0	0	0
	All Ages	30	1 00	10	18	1	1	0 67
1999	2	33	0 85	31	2	0	0	0 06
	3	3	0 08	0	3	0	0	1 00
	4	1	0 03	0	1	0	0	1 00
	5	2	0 05	0	0	2	0	1 00
	6	0	0	0	0	0	0	0
	All Ages	39	1 00	31	6	2	0	0 21
2000	2	11	0 69	11	0	0	0	0
	3	3	0.19	0	3	0	0	1 00
	4	1	0 06	0	0	1	0	1 00
	5	0	0	0	0	0	0	0
	6	1	0 06	0	0	1	0	1 00
	All Ages	16	1 00	11	3	2	0	0 31
All years	2	384	0 82	374	10	0	0	0 03
	3	30	0 06	2	28	0	0	0 93
	4	37	0 08	0	31	6	0	1 00
	5	11	0 02	0	0	8	3	1 00
	6	4	0 01	0	0	3	1	1 00
	All Ages	466	1 00	376	69	17	4	0 19
Proportion of repeat spawners					0 77	0 19	0 04	

Table 6. Sea age and number of repeat spawners displaying alternate, consecutive or mixed patterns of spawning in the Buctouche R., 1992-2000.

	Repeat Spawners								
Sea Age	R-1SW			R-2SW					All
Years	Alt	Con	Total	Alt	Alt/Con	Con	Con/Alt	Total	Repeats
2	-	10	10	-	-	-	-	-	10
3	9	-	9	-	-	19	-	19	28
4	-	-	-	31	-	6	-	37	37
5	-	-	-	-	7	3	1	11	11
6	-	-	-	3	1	-	-	4	4
All Ages	9	10	19	34	8	28	1	71	90
Prop.of Repeats	0.10	0.11	0.21	0.38	0.09	0.31	0.01	0.79	1.00

Table 7. Proportion of females in Buctouche R. salmon, 1993-2000. Fish were not sexed in 1992.

	Maiden Spawners				Repeat Spawners						
	1SW		2SW		R-1SW		R-2SW		All MSW		
Year	Female Prop.	N	Female Prop.	N	Female Prop.	N	Female Prop.	N	Female Prop.	N	Total N
1993	0.19	26	0.80	41	0	1	1.00	2	0.80	44	70
1994	0.03	31	0.87	45	0	3	0.80	10	0.81	58	89
1995	0.18	65	0.80	41	0	1	0.80	10	0.79	52	117
1996	0.04	50	0.90	49	0.33	3	1.00	4	0.88	56	106
1997	0.08	48	0.90	88	0	3	1.00	16	0.89	107	155
1998	0.04	26	0.70	10	0	4	0.75	16	0.63	30	56
1999	0.21	29	0.87	31	0.50	2	0.83	6	0.85	39	68
2000	-	-	1.00	11	0	0	0.80	5	0.94	16	16
All years	0.11	275	0.86	316	0.12	17	0.86	69	0.83	402	677
Mean Prop	0.11		0.86		0.10		0.87		0.82		

Table 8. Proportion of females in various spawning categories relative to freshwater (FW) age, Buctouche R., 1992-2000.

	FW Age = 2 yrs		FW Age = 3 yrs		
Spawning Category	Female Prop.	N	Female Prop.	N	Total N
1SW	0.16	124	0.08	136	260
2SW	0.90	213	0.82	98	311
R-1SW	0.10	10	0.14	7	17
R-2SW	0.85	48	0.86	21	69
Total N		395		262	657

Table 9. Mean fork length (FL) of 1SW, 2SW and all MSW salmon, Buctouche River, 1992-2000. Fish were not sexed in 1992. Not shown are 3SW salmon in 1992 only (see text).

		1SW			2SW			MSW		
Year	Sex	Mean FL (cm)	SD	N	Mean FL (cm)	SD	N	Mean FL (cm)	SD	N
1992	All fish	57.5	4.7	21	75.3	3.3	58	76.6	6.1	64
1993	F	52.2	3.6	5	75.7	3.3	33	76.1	4.2	35
	M	54.1	3.9	21	75.4	4.5	8	77.6	7.8	9
	All fish	53.7	3.9	26	75.6	3.5	41	76.4	5.1	44
1994	F	56.5	-	1	77.1	2.7	39	79.0	5.5	47
	M	57.6	2.9	30	79.1	2.7	6	78.5	5.9	11
	All fish	57.6	2.9	31	77.3	2.7	45	78.9	5.5	58
1995	F	55.6	2.3	12	76.6	4.2	33	78.6	6.3	41
	M	55.7	2.2	53	78.1	4.3	8	81.9	8.8	11
	All fish	55.7	2.2	65	76.9	4.2	41	79.2	6.9	52
1996	F	52.5	0.7	2	76.2	3.7	44	77.8	6.1	49
	M	55.8	2.4	48	75.5	4.0	5	71.5	7.8	7
	All fish	55.6	2.5	50	76.1	3.7	49	77.0	6.6	56
1997	F	54.3	2.5	4	75.6	2.9	79	78.5	7.2	95
	M	57.1	3.6	44	79.2	5.5	9	77.3	6.9	12
	All fish	56.9	3.6	48	76.0	3.4	88	78.4	7.1	107
1998	F	64.0	-	1	75.1	4.6	7	85.1	9.5	19
	M	55.9	3.0	25	76.7	6.4	3	82.7	9.8	11
	All fish	56.2	3.4	26	75.6	4.9	10	84.2	9.5	30
1999	F	58.3	2.3	6	75.7	3.1	27	77.2	6.3	33
	M	57.5	2.7	23	79.8	4.1	4	77.2	7.7	6
	All fish	57.7	2.6	29	76.2	3.4	31	77.2	6.4	39
2000	F	-	-	-	77.0	1.9	11	78.8	3.8	15
	M	-	-	-	-	-	-	97.0	-	1
	All fish	-	-	-	77.0	1.9	11	79.9	5.9	16
All Years	F	55.5	3.5	31	76.1	3.3	273	78.5	6.6	334
	M	56.3	3.1	244	77.7	4.5	43	78.8	8.4	68
	All fish	56.2	3.1	275	76.3	3.5	316	78.5	6.9	402

Table 10. Mean fork length (FL) of repeat spawners by sea age, spawning category and spawning pattern, Buctouche R., 1992-2000.

		Repeat Spawners								
Sea Age		R-1SW			R-2SW					All
Years	Data	Alt	Con	Total	Alt	Alt/Con	Con	Con/Alt	Total	Repeats
2	Mean FL (cm)	-	65.4	65.4	-	-	-	-	-	65.4
	SD	-	3.2	3.2	-	-	-	-	-	3.2
	N	-	10	10	-	-	-	-	-	10
3	Mean FL (cm)	86.1	-	86.1	-	-	82.3	-	82.3	83.5
	SD	4.7	-	4.7	-	-	4.9	-	4.9	5.1
	N	9	-	9	-	-	19	-	19	28
4	Mean FL (cm)	-	-	-	92.1	-	86.0	-	91.1	91.1
	SD	-	-	-	3.4	-	3.2	-	4.0	4.0
	N	-	-	-	31	-	6	-	37	37
5	Mean FL (cm)	-	-	-	-	94.7	94.3	91.0	94.3	94.3
	SD	-	-	-	-	2.6	11.0	-	5.4	5.4
	N	-	-	-	-	7	3	1	11	11
6	Mean FL (cm)	-	-	-	98.3	96.0	-	-	97.8	97.8
	SD	-	-	-	2.3	-	-	-	4.0	4.0
	N	-	-	-	3	1	-	-	4	4
All Ages	Mean FL (cm)			74.6					89.6	86.6
	SD			11.3					6.5	9.7
	N			19					71	90

Table 11. Mean fork length (FL) of repeat spawners by sea age and spawning history, Buctouche R., 1992-2000. First figure indicates total sea age (yrs), followed by sea ages at which the fish spawned.

	Repeat Spawners		
Sea Age and spawning history	Mean FL (cm)	SD	N
2.1	65.4	3.2	10
3.1	86.1	4.7	9
3.2	82.3	4.9	19
4.2	92.1	3.4	31
4.23	86.0	3.2	6
5.23	91.0	-	1
5.234	94.3	11.0	3
5.24	94.7	2.6	7
6.24	98.3	2.3	3
6.245	96.0	-	1
All repeats	86.6	9.7	90

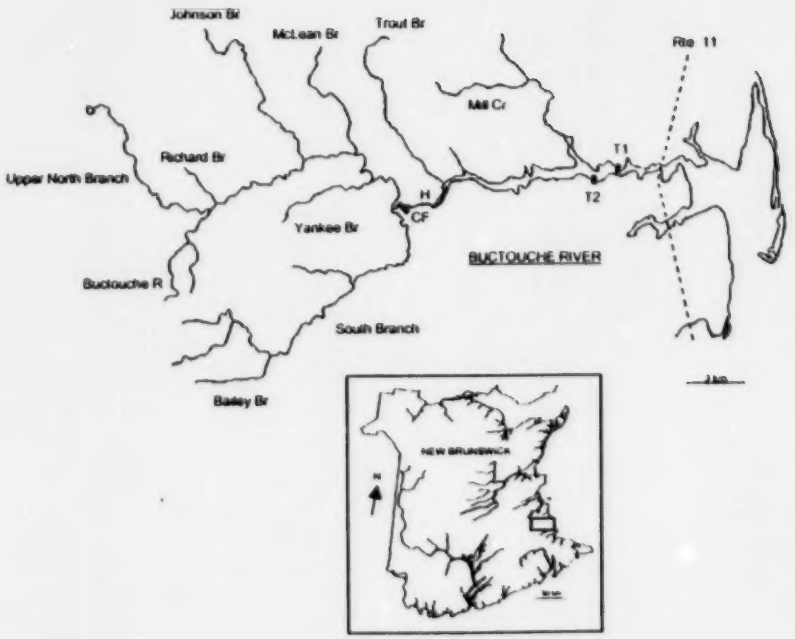

Figure 1. The Buctouche River watershed and locations of trapnets (T1,T2), head of tide (H) and counting fence (CF).

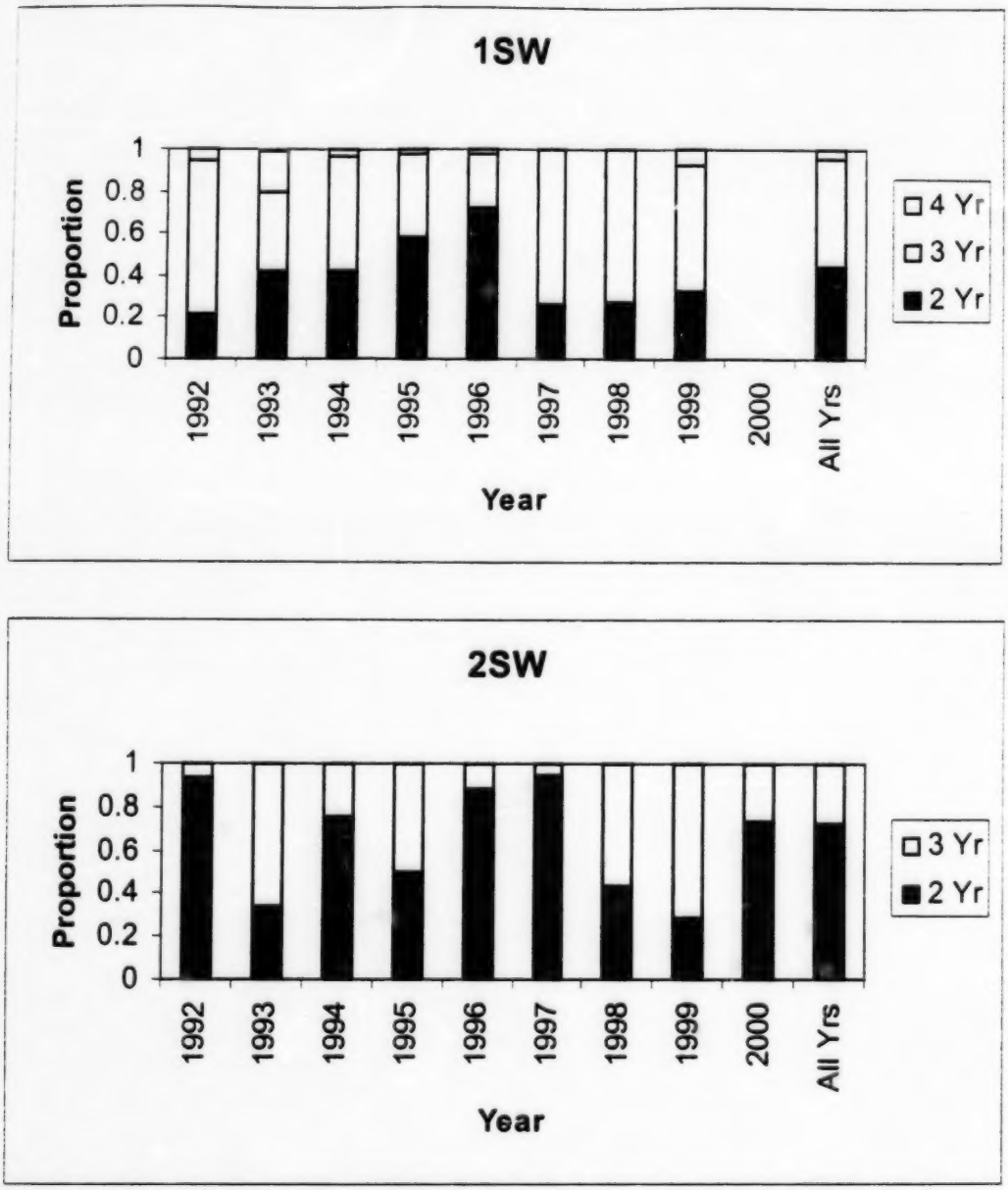

Figure 2. Proportion of freshwater ages in 1SW and 2SW maiden salmon sampled from the Buctouche R., 1992-2000. Small (1SW) fish were not sampled in 2000.

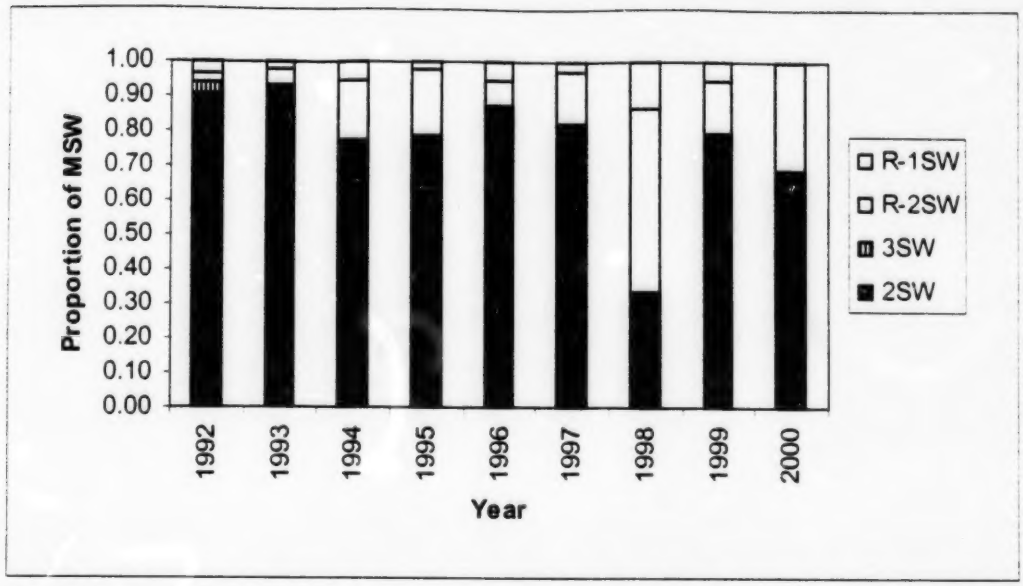

Figure 3. Spawning category as proportion of all MSW salmon, Buctouche R., 1992-2000.

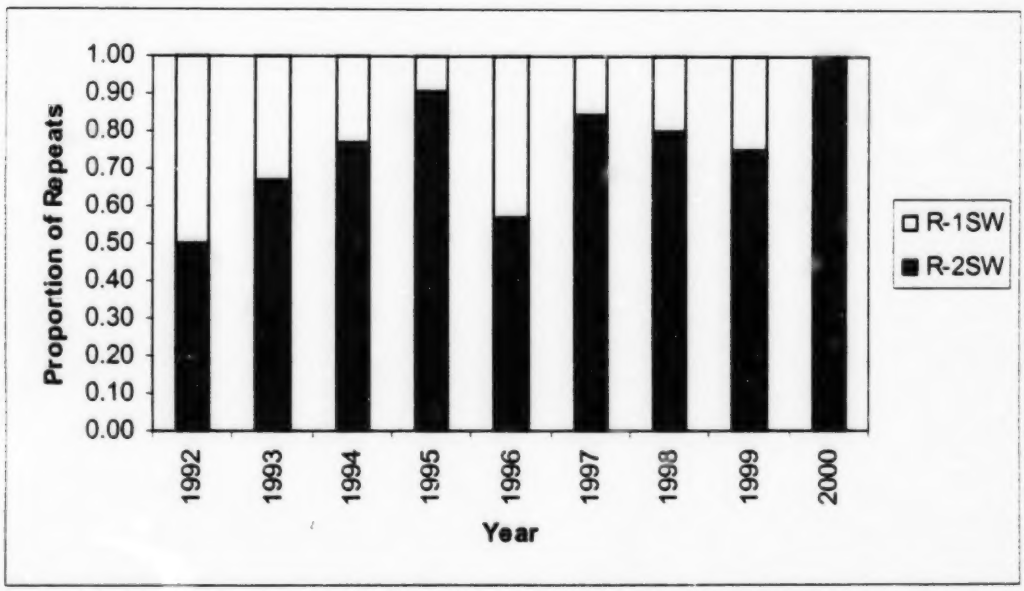

Figure 4. Repeat spawning category as proportion of all repeat spawners, Buctouche R., 1992-2000.

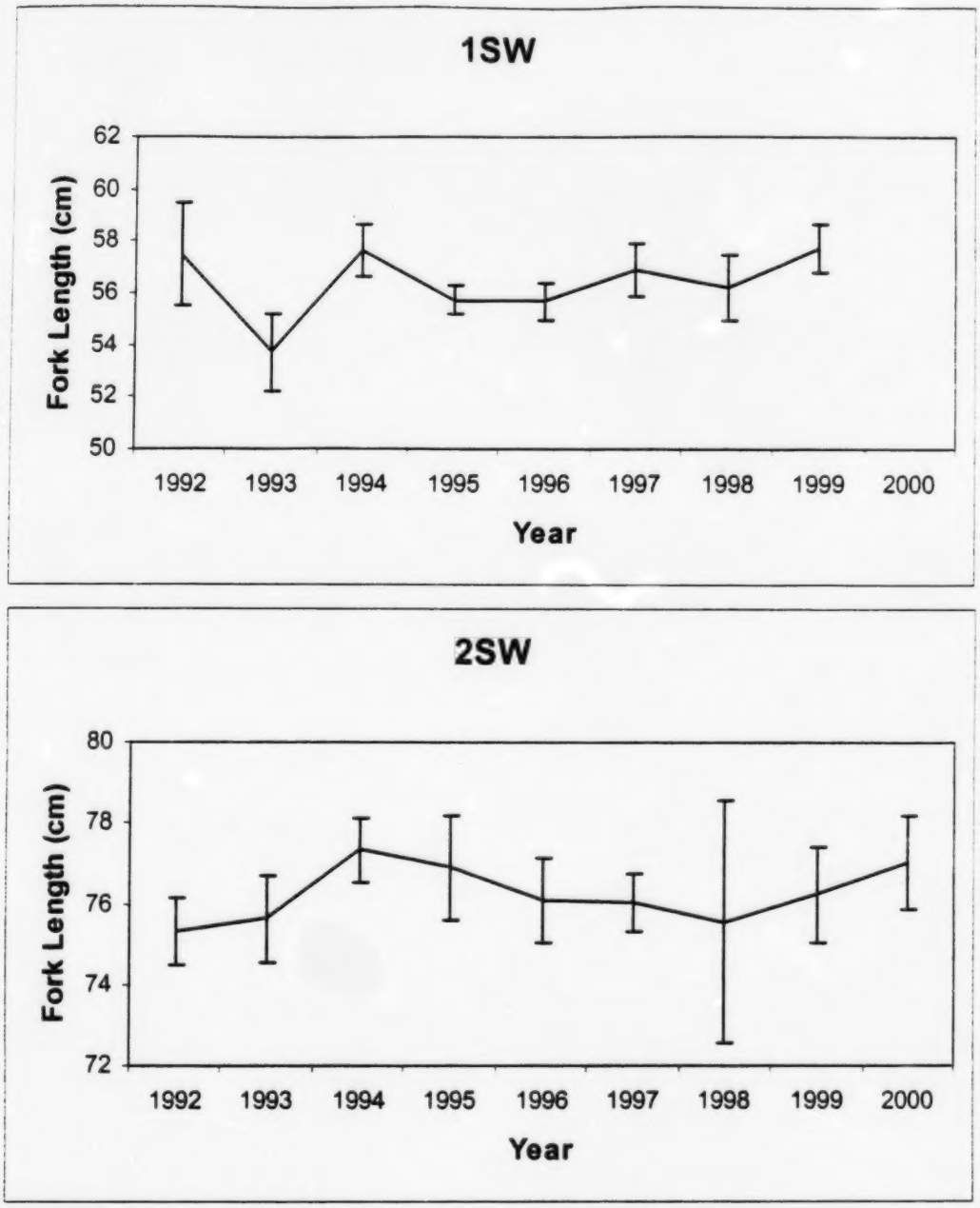

Figure 5. Mean fork length and 95% confidence interval for 1SW and 2SW maiden salmon, Buctouche R., 1992-2000. Small (1SW) fish were not sampled in 2000.